REMARKS

CLAIM OBJECTIONS

In the Office action of December 14, 2005, the Examiner objected to claims 12, 15 and 18. More specifically, the Examiner indicated that claim 12 improperly recited "sub(2)," and that claims 15 and 18 improperly recited "com."

Applicants appreciate the Examiner noting these grammatical errors. Applicants have amended claim 12 to properly recite "substrate" and have amended claims 15 and 18 to properly recite "comprising."

In view thereof, withdrawal of the objections is respectfully requested.

CLAIM REJECTIONS UNDER 35 USC § 112

The Examiner rejected claims 1-26 under 35 USC § 112, first paragraph, as failing to comply with the enablement requirement. More specifically, the Examiner indicated that the Applicants disclosure did not appear to teach any microstructural difference other than porosity, which imparted the differences in thermal conductivity and strength such that the independent claims should reflect that the porosity is the microstructural difference.

With regard to independent claims 1 and 12, Applicants have amended such claims to recite that the porosity of the first layer is different from that of the second layer. Similarly, new independent claim 27 recites that the porosity of the first layer is different than that of the second layer.

With regard to claim 18, the Examiner indicated that she was not familiar with the HOSP process described in the specification and claims. In view thereof, Applicants have included, in the **Appendix** section attached hereto, literature which briefly describes HOSP (Homogeneous Oven Spherical Powder) and various other spray processes. It should be appreciated that HOSP is also known as "Hollow Oven Spherical Powder." In view of the enclosed literature, which based on information and belief was printed in 1992, Applicants respectfully submit that HOSP is known to those having ordinary skill in the art of spray processes and coatings.

With regard to the rejection of claims 11 and 17, Applicants have canceled claim 11. With regard to claim 17, the Examiner is directed to paragraphs [0027], [0028], [0043], [0044] and [0045] of the instant specification, which describe the first and second powders and their application. As described in paragraph [0043], the particles of the first powder are fully, or nearly fully melted when they hit the

substrate/bond coating, which thereby forms a dense, substantially porous-free layer. As described in paragraphs [0028] and [0045], the second powder is preferably produced by the HOSP process, which forms a shell or coating of the melted powder material about the grains of the powder. As a result, the second powder particles only partly melt to thereby form a more porous layer.

With regard to claim 23, Applicants have removed the term "preferably."

In view of the above, withdrawal of the rejection is respectfully requested.

CLAIM REJECTIONS UNDER 35 USC § 102

The Examiner rejected claims 1-6, 8-20, 25 and 26 as being anticipated by Beltran et al. (EP 0605196). More specifically, the Examiner indicated that Beltran et al. teaches a thermal barrier comprising a first zirconia layer and a second zirconia layer, wherein the first layer has substantially zero porosity and the second layer has 10-20% porosity. Applicants respectfully traverse the rejection inasmuch as it may apply to the claims as amended.

At the outset, it should be appreciated that Bertran et al. disclose utilizing a powder that has the same microstructure to form both the first and the second layers and do not disclose using different powders to form the first and second layers. Additionally, Bertran et al. disclose that when forming the first layer, the substrate is heated to a temperature between 600-1200 degrees Fahrenheit, and when forming the second layer, the substrate is allowed to cool to a temperature that is between ambient and 600 degrees Fahrenheit before the powder is applied. Consequently, Bertran et al. is silent with regard to the shape and/or orientation of the pores.

In the instant case, Applicants amended independent claim 1 includes the limitation that the second outer layer contains pores that are flattened out and directed substantially in parallel with the substrate (see paragraph [0045] of the instant specification). This is largely attributed to the fact that when the second powder, which is partially melted, impacts with the first layer, particle boundaries (a/k/a "splat boundaries") are formed, which contain voids and pores that are flattened out and in a plane generally parallel with the plane of the substrate/underlying material. Bertran et al. does not disclose a like manner of applying a second layer and is wholly silent regarding the orientation and shape of pores. Consequently, this feature is not explicitly or implicitly disclosed by Bertran et al. Additionally, amended independent claims 1 and 12 further recite that the pores are formed by depositing powder particles comprising an agglomerate of powder grains surrounded by a shell of the melted powder material. Bertran et al. do not disclose a powder having a similar microstructure. Finally, independent

claims 12 and 27 further recite that the microstructure of the first powder is different from the second powder. Bertran et al. does not disclose that different structured powders are used for depositing the first and second layers, but rather, discloses altering the temperature of the substrate to obtain differently structured layers.

Consequently, because each and every element as set forth in the claims is not found, either expressly or inherently, as arranged in Bertran et al., Applicants respectfully submit that independent claims 1, 12 and 27, and those claims depending therefrom, are not anticipated by Bertran et al.

In view thereof, withdrawal of the rejection is respectfully requested.

CLAIM REJECTIONS UNDER 35 USC § 103

The Examiner rejected claims 7, 11, 15, 21-24 as being obvious in view of the teachings of Bertran et al. and Alperine (US 6,33,118) or Bertran et al. and Strutt (US 6,247,448).

With regard to the rejection of claims 7 and 21 in view of Bertran et al. and Alperine, the Applicants respectfully submit that claims 7 and 21 are nonobvious by virtue of their dependency from nonobvious claims 1 and 12. As discussed in the rejection under 35 USC § 102 above, Bertran et al. does not disclose, teach or suggest using powders having different microstructures to form the first and second layers as required by claim 12 and does not disclose, teach or suggest that the second layer is formed by depositing powder particles comprising an agglomerate of powder grains surrounded by a shell of melted powder material as required by each of claims 1 and 12. On the contrary, Bertran et al. discloses the use of an indentically structured powder and altering the temperature of the substrate to form the differently structured layers. Similarly, Alperine, does not disclose, teach or suggest using powders having different microstructures to form the first and second layers and does not disclose, teach or suggest that the second layer is formed by depositing powder particles comprising an agglomerate of powder grains surrounded by a shell of melted powder material. On the contrary, Alperine specifically discloses "dense pellets having equivalent residual porosity levels." (Col. 5, lines 33-35).

Likewise, with regard to claims 11, 15, 22, 23 and 24, Applicants respectfully submit that such claims depend from nonobvious claims 1 and 12. As noted above, Bertran et al. does not disclose, teach or suggest using powders having different microstructures to form the first and second layers as required by claim 12 and does not disclose, teach or suggest that the second layer is formed by depositing powder particles comprising an agglomerate of powder grains surrounded by a shell of melted powder material as required by each of claims 1 and 12. On the contrary, Bertran et al. discloses the use of an indentically

structured powder and altering the temperature of the substrate to form the differently structured layers. Similarly, Stratt does not disclose, teach or suggest differently structured microstructures for preparing first and second layers. Stratt discloses a method for reprocessing nano-particle powders to an aggregate form suitable for spray deposition, which are used to obtain coatings displaying "negligible porosity…" (See Col. 3, lines 62-63 (Emphasis added); See also FIG. 4b and Col. 6, lines 46-55)). Additionally, the powders disclosed by Stratt as having an outer shell are also described as having an inner uniform hard particle phase (See FIGS. 1. and FIGS. 4a-4b; See also Col. 6, lines 35-48).

These features are in contrast to the instant claims. Furthermore, Stratt's teaching of preparing coatings having negligible porosity teaches away from the present invention such that there is no motivation to combine the reference teachings as suggested by the Examiner. Finally, Stratt concerns nanostructure SiC_xN_y powders such as SiO_2, SiC and Si_3N_4 and does not disclose, teach or suggest thermal barrier layers. Consequently, one having skill in the art would not look to combine the teachings of Stratt with Bertran et al. Therefore, Applicants respectfully submit that the instant claims are non-obvious in view of Bertran et al. and Stratt and respectfully request the Examiner withdraw the rejections.

CONCLUSION

Applicants respectfully submit that the instant application is now in condition for allowance, which action is courteously requested.

The undersigned representative requests any extension of time that may be deemed necessary to further the prosecution of this application.

The undersigned representative authorizes the Commissioner to charge any additional fees under 37 C.F.R. 1.16 or 1.17 that may be required, or credit any overpayment, to Deposit Account No. 14-1437, Order No. 7589.0056.NPUS01.

In order to facilitate the resolution of any issues or questions presented by this paper, the Examiner should directly contact the undersigned by phone to further the discussion.

Respectfully submitted,

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Appendix

The attached appendix includes the following documents which discuss HOSP (Homogenous Oven Spherical Powder, Hollow Oven Spherical Powder).

1. Berndt, Christopher C., Ph.D., "Materials Production for Thermal Spray Processes," ASM International, pp. 1, 17-18, August 1992. Full text available at: http://www.matscieng.sunysb.edu/Berndt/Papers/1992%20BERNDT%20Materials%20C&R.pdf

The Materials Information Society

Materials Production for Thermal Spray Processes

A lesson from THERMAL SPRAY TECHNOLOGY

by
Christopher C. Berndt, Ph.D.

Course 51
Lesson, Test 4

MATERIALS ENGINEERING INSTITUTE

close-clearance seal. The metallic components of these coating systems have good high-temperature resistance and permit satisfactory bonded porous structures to be formed for special purpose abradable seals.

Plasma Fusion. A representative process for a plasma fusion method is the technique used to manufacture the hollow-oven spherical powder (known as the HOSP process). The HOSP process involves the thermal spray processing of spray-dried materials. The powders are melted in the heat source to form spherical particles that are hollow. The particles are collected and then classified by the usual processes. The process is applied to ceramics such as alumina, zirconia and chromia-based materials to form powders with good flowing characteristics. The manufacturers of this product claim that the good powder feeding properties of so-formed materials, together with their chemical homogeneity

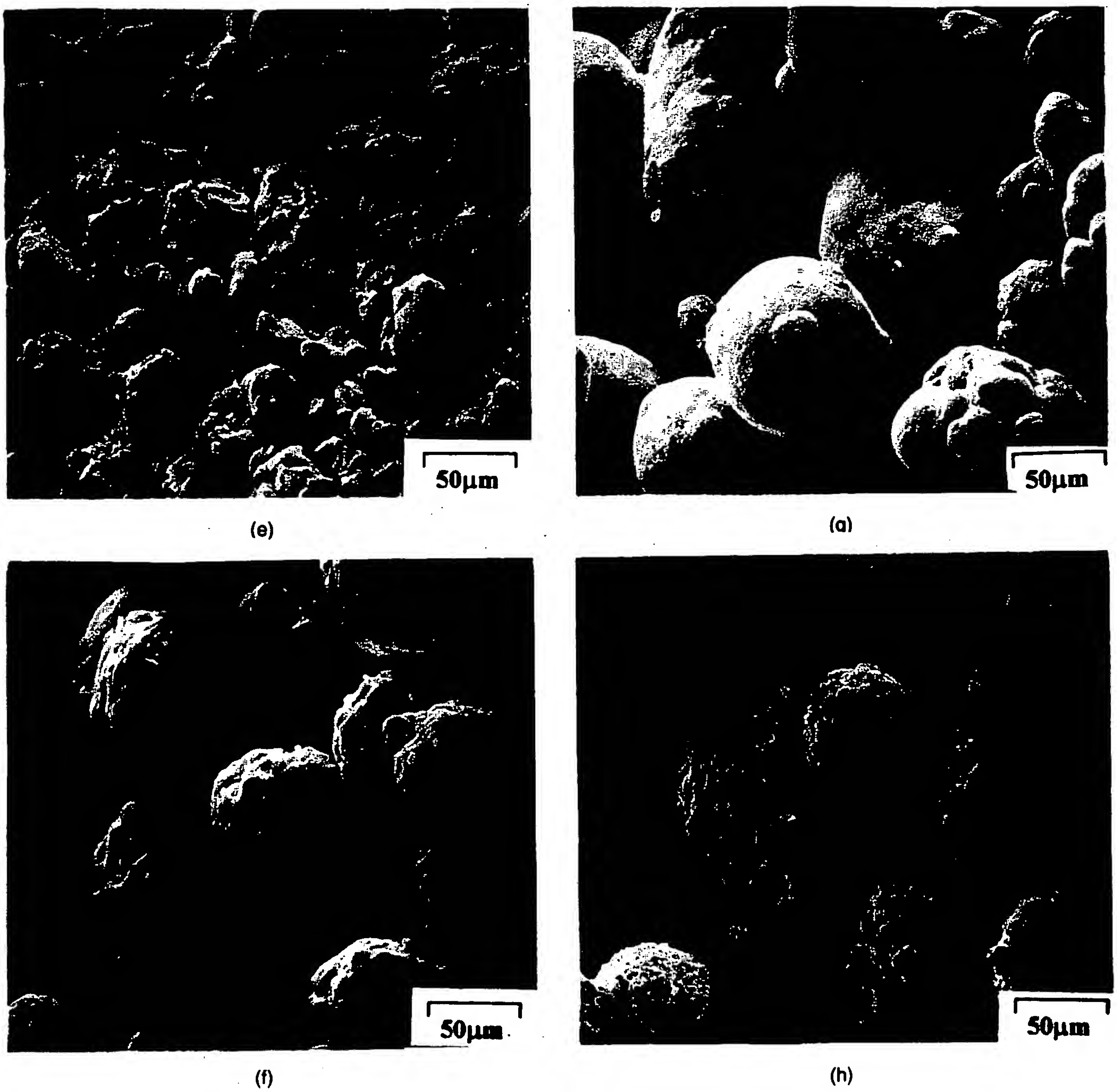

Figure 12. (cont'd)

and ability to melt high-melting-point materials within the thermal spray stream, achieves a superior coating to one obtained from powders produced from a fused and crushed route. The basis of the higher-productivity argument is that hollow spheres allow more-uniform melting behavior.

Agglutination. A new laboratory technique for producing ceramic / metal composite powders is the agglutination process. This is a low-temperature process, on the order of 50 to 85°C (120 to 185°F). The ceramic cores are first tumbled in a binder phase of polyethylene glycol to form a uniform coating. The binder phase is about 4 wt% of the powder. The second step is to cool down the mixture and break it up by conventional milling. The coated cores and fine metal powder (5 to 10 microns) are charged into a tumbling furnace where they combine to form a metal-coated core. The advantage of this process, other than the technical simplicity, is that it is very energy efficient and virtually unlimited with regard to the combinations of materials that can be formed into a composite.

Blended and Co-Deposited Powders. A final aspect of feedstock preparation that concerns the topic of composite powders is that of blended powders and co-deposited powders. Blended powders are mechanical mixtures of separate components; i.e., the blended powder is fed through only one power port. Care must be taken that the constituents of the powder blend have the ability to be sprayed with identical thermal spray parameters; otherwise no coherent deposit will form. These powders therefore require adjustment of the appropriate particle size distribution with respect to their weight loading in the composite coating.

Co-deposited materials have very similar structures as blended materials but are formed from a dual powder-feeding arrangement. The powder ports may enter the flame at either the same location (if they require the same thermal trajectory), or at different locations (if they need different thermal heating). One advantage of the dual port system over the blended powder technique is that a continuous adjustment of the composite chemistry can be achieved. Such coatings are referred to as graded.

Particle Morphology and Porosity

The prior sections have indicated that the particle morphology is not only an important part of the powder feeding stage but that it can also be controlled. The range of particle morphologies that may be produced is shown in Figure 12. Particle morphology is most commonly ascertained with either scanning electron or optical microscopy. The use of the electron microscope has the additional ability of checking the chemical analysis of the material if the microscope is equipped with an analytical facility.

The shape of the particles gives a most important indication of the processing methods for the material since the surface textures of the particles have quite different characteristics, depending on the method. These morphological features also allow the flow capability of the materials to be qualitatively ascertained, if it can be assumed that perfectly flowing material would be mono-sized and have smooth surfaces.

The spray dried, sol-gel manufactured composite and the agglomerated and sintered feedstock materials have characteristic globular features on the surface. The scale of these features is less than about 5 microns; however, they do not disrupt the overall spherical nature of the individual particles and therefore the flow characteristics of these materials are good. The fused and crushed materials are clearly distinguished as having smooth fracture surfaces which are indicative of their manufacturing method. Their shape is not spherical and can be thought of as being very irregular in shape. These powders are quite dense and they are sensitive to flow characteristics due to a non-ideal geometry.

The individual feedstock particles may also exhibit very fine particles (less than 1 micron) on their surfaces. These fines are indicative of either strong electrostatic forces within the body of the powder or

Table 1. Standard Sieves for Most Thermal Spray Powders

Sieve size number	Microns	Inches
100	149	0.0059
120	125	0.0049
140	105	0.0041
170	88	0.0035
200	74	0.0029
230	62	0.0024
270	53	0.0021
325	44	0.0017
400	37	0.0015
500	31	0.0014

This MEI Homestudy Lesson is dedicated to the memory of Paul B. Urban, Manager of New Product Development in the Education Department at ASM International until his untimely death in 1991.